The U.S. Global Change Research Program is an integrated, multiagency effort that helps the nation and world understand, assess, predict, and respond to global change. Eleven agencies within the federal government, including EPA's Global Change Research Program within ORD, participate in the U.S. Global Change Research Program.

EPA's Program is assessment-oriented and focuses on the potential consequences of climate variability and climate change on human health, ecosystems, and social well-being in the United States. In addition, the Program investigates the effects of multiple stresses, the human dimensions of global change (as human activities influence and respond to global change), and adaptation options that can build resilience to change. The goals of EPA's Global Change Research Program are consistent with three key elements of the U.S. Program's Strategic Vision for the next decade: develop regional-scale predictions of the interactions among natural and human-induced changes; determine the vulnerability of natural resources and evaluate options for enhancing resilience; and provide useful knowledge for decision making by governments, communities, and the private sector.

REGIONAL-SCALE CONSEQUENCES

As part of its commitment to the U.S. Program, EPA's Global Change Research Program is sponsoring assessments in the Mid-Atlantic, Great Lakes, and Gulf Coast areas. The first peer-reviewed assessment reports were published in 2001 as part of the U.S. Program's first National Assessment. These ongoing assessments are conducted through public-private partnerships that engage researchers from the academic community, resource and environmental managers, and other affected stakeholders. The focus of the assessments on specific geographic areas reflects the fact that the effects of climate change will differ across the nation and that people will experience these impacts where they live.

The Mid-Atlantic assessment concluded that climate change may have a positive impact on agricultural production of soybeans, and possibly corn and tree fruits, but a negative impact on tobacco production. Increased temperatures will make urban heat stress more likely. Forests might grow a little faster, but extreme weather events such as tornados and floods could disrupt the pattern of revenues from forestry operations. Rising sea levels will almost certainly occur, with the potential for

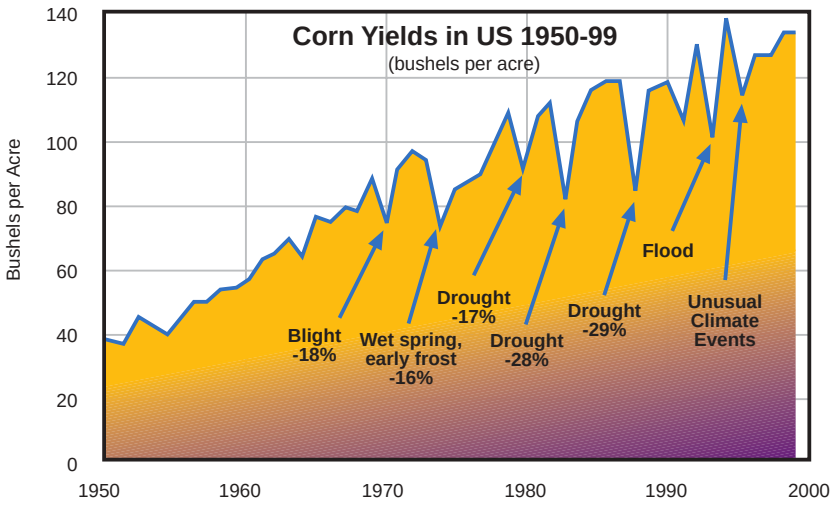
substantial damage to coastal structures, wetlands and estuaries, and to water supplies because of salt water intrusion. What are now considered one-hundred-year floods will occur every 25 to 30 years. Such storms can disrupt human communities, transportation, waste treatment, emergency services, and wildlife

ORD scientist measuring light-harvesting efficiency of salt-marsh plants.

habitats. Resource managers are working to identify and design effective, site-specific adaptive measures in anticipation of future sea level rise.

The Great Lakes assessment concluded that, despite a projected increase in precipitation, increased evaporation due to higher summer air temperatures will lead to lower water levels in the Great Lakes. Lower lake levels will reduce hydroelectric power generation downstream, with projected reductions up to 15% by 2050. An increase in demand for water across the region at the same time net flow decreases is of particular concern. Lower lake levels are also a concern for the commercial shipping industry because locks and channels may become too shallow for big ships to pass through. As a result of the assessment, this industry is considering options such as lengthening the shipping season, redesigning ships to have a shallower draft, redesigning locks and channels to accommodate the new ships, and dredging shallow channels.

The Gulf Coast Regional Assessment concluded that increasing temperatures and carbon dioxide may increase production of certain agricultural crops, but this benefit may be offset by problems with runoff of agricultural chemicals to coastal wetlands and seawater contamination of agricultural soil. Rising sea levels are expected to lead to salt water intruding inland where it will mix with surface and ground waters. Also, changing precipitation

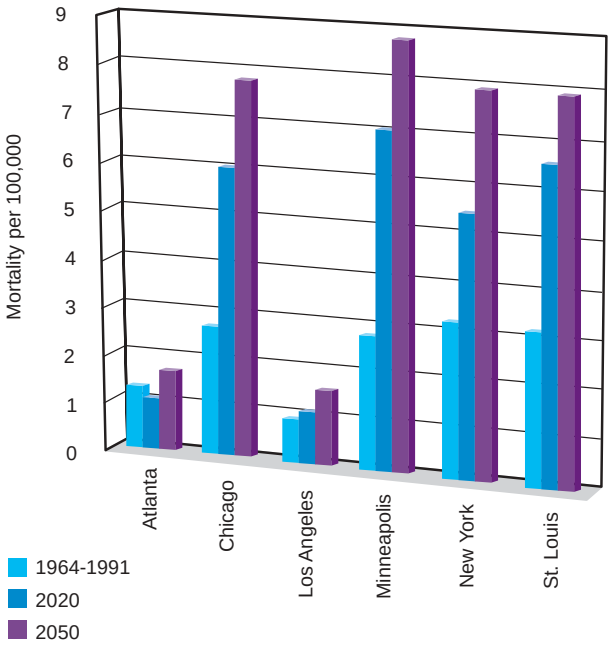


Reductions in corn yields often correspond to extreme climate events such as droughts and floods.

patterns in the central United States will alter the timing and delivery of fresh water to estuaries along the Gulf Coast. Changing salinity patterns will threaten the stability of freshwater coastal ecosystems and shellfish stocks, especially oysters and shrimp.

HEALTH CONSEQUENCES

EPA's Global Change Research Program is also sponsoring ongoing Health Sector Assessments. These assessments examine the potential impacts of climate variability and change on human health. The first Health Sector Assessment, conducted as part of the U.S. Program's first National Assessment, was published in May 2001. It identified five categories of health outcomes that are most likely to be affected by climate change because they are associated with weather and/or climate variables: temperature-related morbidity and mortality; health effects of extreme weather events (e.g., storms, tornadoes, hurricanes, floods, and blizzards); air pollution-related health effects; water- and food-borne diseases; and insect- and rodent-borne diseases. The report also identified groups at risk, key research areas, and public health measures that, if properly addressed, could improve the public's resilience to risks associated with current climate variability and future climate change. Uncertainties about many future variables, including population, economic conditions, other possible health or societal priorities (e.g., an unanticipated epidemic or war), as well as the complexities of human behavior, are acknowledged and addressed in the analysis.

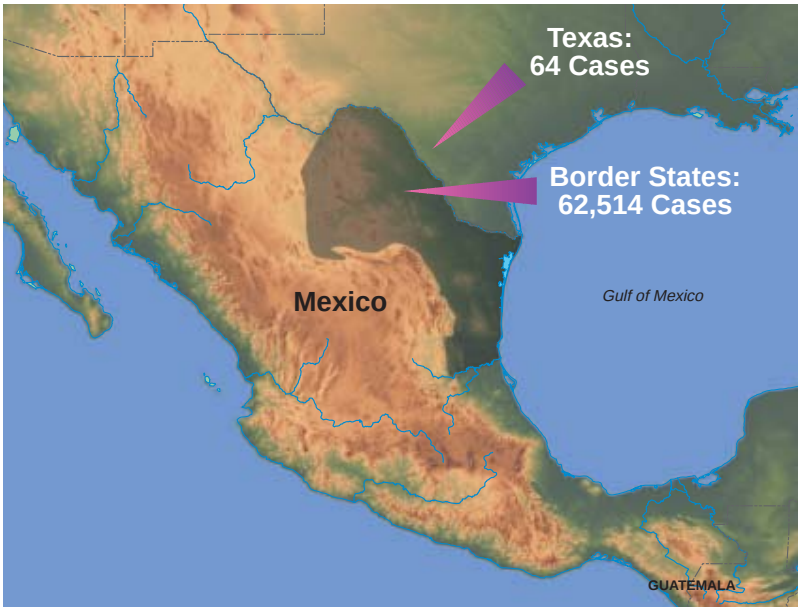


Average Summer Mortality Rates Attributed to Hot Weather Episodes. Deaths due to summer heat are projected to increase in U.S. cities. Because heat-related illness and death appear to be related to temperatures much hotter than those to which the population is accustomed, cities that only infrequently experience extreme heat appear to be at greatest risk. Note: Estimates for 2020 and 2050 are based on the Max Planck GCM model results (IPCC 1994).

The Health Sector Assessment made great progress toward understanding the potential consequences of climate variability and change for human health in the United States and provided timely and useful information for public health officials and other decision makers. The report concluded that the United States has a solid public health infrastructure. However, we are frequently reminded that human health is inextricably bound to weather and the many complex natural systems it affects. Weather-related deaths, such as fatalities in heat waves and floods, and illnesses such as water-borne and vector-borne diseases continue to occur. The future vulnerability of the U.S. population to the health impacts of climate change depends on our capacity to adapt to potential adverse changes. Approaches to reduce vulnerability include building codes and zoning to prevent storm or flood damage, severe weather warning systems, improved disease surveillance and prevention programs, improved sanitation systems, better education of health professionals and the public, and additional research addressing key knowledge gaps in climate-health relationships.

PUBLIC ACCESS TO INFORMATION

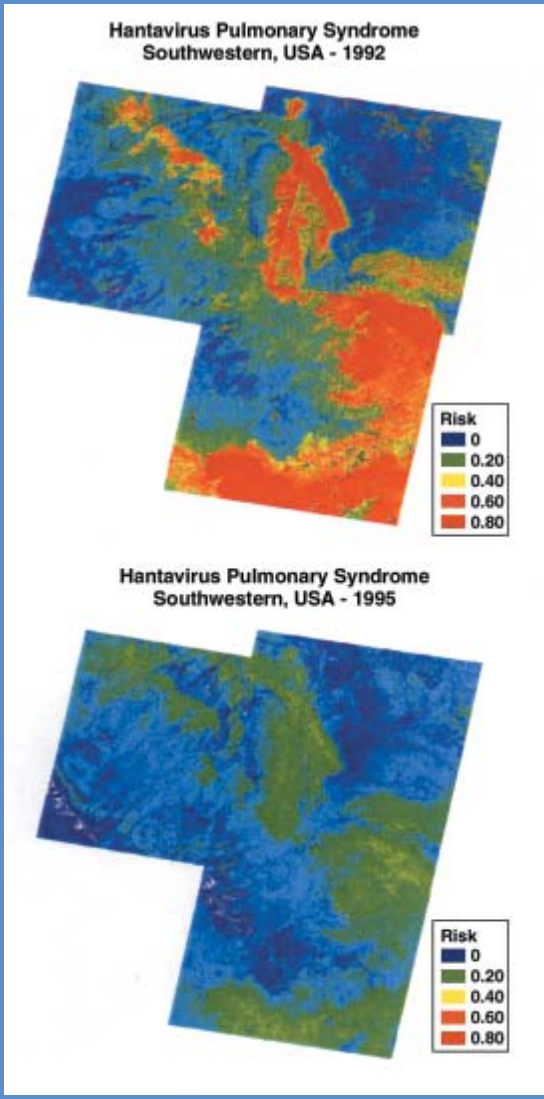
The U.S. Global Change Research Program is committed to providing timely and useful information to decision makers. In November 2000, the program successfully established a web site through which scientists, resource managers, policy analysts, and the public can access information about the Program. The goal is to make the products from EPA researchers, grantees, and other collaborators–including data, results of EPA-sponsored assessments, project descriptions and updates, workshop announcements and proceedings, and analytic tools–readily available to interested parties.



Dengue fever along the U.S.-Mexico border. A mosquito-borne viral disease, dengue fever was once common in Texas, where there were an estimated 500,000 cases in 1922. The mosquito that transmits the virus remains abundant. The striking contrast in the incidence of dengue in Texas versus three Mexican states that border Texas (64 versus 62,514 reported cases from 1980-1999) provides a graphic illustration of the importance of factors such as use of air conditioning and window screens in interrupting the transmission of vector-borne diseases. This is one example of how relatively simple adaptive measures can reduce the health impact of a climate-related vector-borne disease.

Preventing Hantavirus Pulmonary Syndrome

In 1993, an outbreak of hantavirus pulmonary syndrome (HPS), a disease characterized by acute respiratory distress with a high death rate (>50%) among previously healthy individuals, occurred in the southwestern United States. This disease was traced to a virus transmitted primarily by deer mice. Researchers hypothesized that the outbreak occurred because unusual weather patterns associated with the 1991-92 El Niño promoted increased vegetation growth that supported increased rodent populations. To explore this hypothesis, an EPA-sponsored study compared the environmental characteristics of sites where people became ill with those at sites where people were not ill. This research found that high-risk areas for Hantavirus Pulmonary Syndrome can be predicted based on satellite-generated maps of land cover over 6 months in advance. Satellite images from 1995, a non-El Niño year, predicted low risk in the area, whereas the images from the 1998 strong El Niño season predicted high risk areas. The risk predictions based on land cover were consistent with the number of HPS cases reported in 1994, 1996, 1998, and 1999. Based on this research, methods for disease prevention were developed in partnership with the Centers for Disease Control and the Indian Health Service and are being implemented by the U.S. Department of Health and Human Services.



LOOKING TO THE FUTURE

Several major research and assessment products are expected during the next two years, including

- *an assessment of the potential impacts of sea level rise on water quality and drinking water systems along the Gulf and Atlantic Coasts;*
- *an interim assessment of the potential effects of global change on urban air quality;*
- *an assessment of the potential consequences of global change on selected watersheds; and*
- *an interactive decision-support tool, implemented through the Global Change Research web site, that supports the decision and analytic needs of water resource managers, coastal zone managers, and agricultural planners.*